

# EARTHQUAKE EVALUATION REPORT

## Summary

Colorado's earthquake hazard and risk has historically been rated lower than most knowledgeable scientists in the state consider justified. As a result, local emergency managers are generally unaware of the size and consequences of an earthquake that could occur in the state. HAZUS 99 gave a probabilistic Annualized Earthquake Loss (AEL) of \$5.8 million which ranked Colorado 30<sup>th</sup> in the nation.

The Colorado Geological Survey (CGS) recently ran a series of deterministic scenarios for selected faults around the state using HAZUS MH. The earthquake magnitudes used for each fault were the "Maximum Credible Earthquake" taken from the USGS Quaternary Fault and Fold Database or from the USGS National Earthquake Hazard Map. The results demonstrate that the probabilistic AEL value of \$5.8 million does not begin to convey the size of the loss that would occur in the event of a strong earthquake on any of these faults. For example, a magnitude 6.5 earthquake on the Golden fault is forecast to result in a \$22 billion economic loss. Or, consider that a magnitude 6.0 earthquake under the Rocky Mountain Arsenal would result in \$3.9 billion economic loss to Adams County alone; and a loss ratio of 17% that would make recovery difficult.

Much additional work is required to more reasonably characterize Colorado's earthquake risk. CGS believes the following areas should receive the highest priority for additional work and mitigation:

1. Training for emergency responders on the consequences of a strong earthquake.
2. Establishment of a comprehensive seismograph network in Colorado.
3. Development of a landslide susceptibility map for Colorado.
4. Better definition of the attenuation factor (Q) for earthquakes in Colorado.
5. Better characterization of Colorado's known Quaternary faults.
6. Better characterization of Colorado's known Neogene faults.
7. Regional investigation for previously undetected Neogene faults.

## Background

In 1960 there were no young faults reported in the literature for Colorado and the dogma being taught in Colorado's institutions of higher education were that the faults in Colorado were all dead, and had been so for 40 million years. Therefore, there was no earthquake hazard in the state.

In 1970, the USGS published a paper that reported eight young faults around the state. By 1980, there were 45. By 1985, there were more than 60. And by 1998, there were more than 90 young faults and folds identified in the state. Clearly, the more we look, the more we find. But, the looking has been dramatically underfunded.

Colorado's earthquake hazard and risk has historically been rated lower than most knowledgeable scientists in the state consider justified. There are a plethora of reasons for this and the reader is referred to the following publications for a comprehensive review:

Matthews, V. 2003, The Challenges of Evaluating Earthquake Hazard in Colorado, *in* Boyer, D.B, Santi, P.M. Rogers, W.P., Engineering Geology in Colorado- Contributions, Trends, and Case Histories, Association of Engineering Geologists Special Publication No. 15, 22 p.

Matthews, V., 2002, We don't have earthquakes in Colorado do we?: RockTalk, Colorado Geological Survey, v. 5, no.2, 12p.  
<http://geosurvey.state.co.us/pubs/rocktalk/rtv5n2.pdf>

Matthews, V., 1973, A reappraisal of the seismic-risk classification of Colorado; Mountain Geologist, V. 10, p. 111-115.

HAZUS is driven primarily by the information in the USGS National Earthquake Hazard Map. Resources have not been adequately devoted to understanding Colorado's earthquake hazard. Consequently, the map probably underestimates Colorado's earthquake hazard. Therefore, a probabilistic analysis of Colorado's risk using HAZUS would also be understated.

Some faults in Colorado have received considerable work on hazards. Many of these investigations were conducted by personnel and consultants for the Bureau of Reclamation as part of their dam safety program. With the exception of investigations on the Cheraw and southern Sangre de Cristo faults, the USGS has conducted very few studies of earthquake hazard in Colorado.

The Colorado Geological Survey, with generally inadequate funding and conflicting priorities, has attempted to categorize the extent of young faulting and earthquakes in the state. Several important publications have resulted:

Kirkham, R.M., and Rogers, W.R., 1999, Colorado earthquake information: 1867-1996: Colorado Geological Survey Bulletin 52, CD-ROM.

Kirkham, R.M., and Rogers, W.P., 1981, Earthquake potential in Colorado: Colorado Geological Survey Bulletin 43, 171 p.

Widmann, B.L., Kirkham, R.M., and Rogers, W.P., 1998, Preliminary Quaternary fault and fold map and database of Colorado: Colorado Geological Survey Open- Report 98-8, 331 p.

### **Deterministic HAZUS Analyses**

HAZUS can perform either probabilistic or deterministic analyses. The probabilistic analyses attempt to use statistical probability to predict what the "Annualized Earthquake Losses (AEL)" are in each part of the state. These are driven by the USGS National Earthquake Hazard Maps. The deterministic analyses provide "what if" scenarios, e.g. what if a magnitude 6.0 earthquake actually did occur under the Rocky Mountain Arsenal (such a possibility can be found in two different scientific papers). What damage would result, and where would it be located?

HAZUS was recently used to evaluate potential damage from an earthquake on a major feature on Colorado's eastern plains. Because the feature was isolated, intuition suggested that a large earthquake on this feature would not cause significant loss and therefore the expenditure of state resources to investigate the feature was not justified. However, a HAZUS deterministic analysis revealed that a large earthquake could cause more than \$11 billion in economic loss, including \$2.6 billion in the City and County of Denver. Based on this information CGS decided to spend the resources to evaluate the possible earthquake history on the feature.

## HAZUS Results

The results of the HAZUS runs are extremely detailed and only the summaries are presented here. The full reports are 20 pages and include such things as casualties broken into several categories of severity and calculated at three different times of the day; building damage broken into categories; highway and utility damage; number of people needing shelter; hospitals able to function at 50% capacity one day after the earthquake, 7 days after the earthquake, and two weeks after the earthquake; post earthquake fires, and volume of debris to clean up.

Following are several portrayals of loss. One report shows losses by counties. One table summarizes losses by fault. One chart shows the top five losses in several categories: five most damaging faults, 14 highest economic losses, five highest loss ratios for counties, and the five highest calculated potential loss by county. One map shows the locations and names of the faults analyzed. The other map shows the losses calculated for each fault. The county summary results are reported in the following format:

### **HAZUS Risk:**

**N Sangre: M7.5 – 4 fatal, \$152.7 Million (-8.0%).**

“N Sangre” is the name of the fault (North Sangre de Cristo fault)

“M7.5” is the magnitude chosen for that scenario

“- 4 fatal” is the number of deaths calculated in the casualty results. There are four levels of severity for casualties with the highest being deaths.

“\$152.7 Million” is the total economic loss which includes direct and indirect

“(-8.0%)” is the loss ratio which is the percentage of the total building stock value damaged. The higher this ratio, the more difficult it is to restore a community to viability.

## Earthquake Susceptibility by Colorado Counties

Fault names and information are from CGS Colorado Late Cenozoic Fault and Fold Internet Map Server: ([http://geosurvey.state.co.us/CGS\\_Online/WEB/LoadMap.cfm](http://geosurvey.state.co.us/CGS_Online/WEB/LoadMap.cfm))

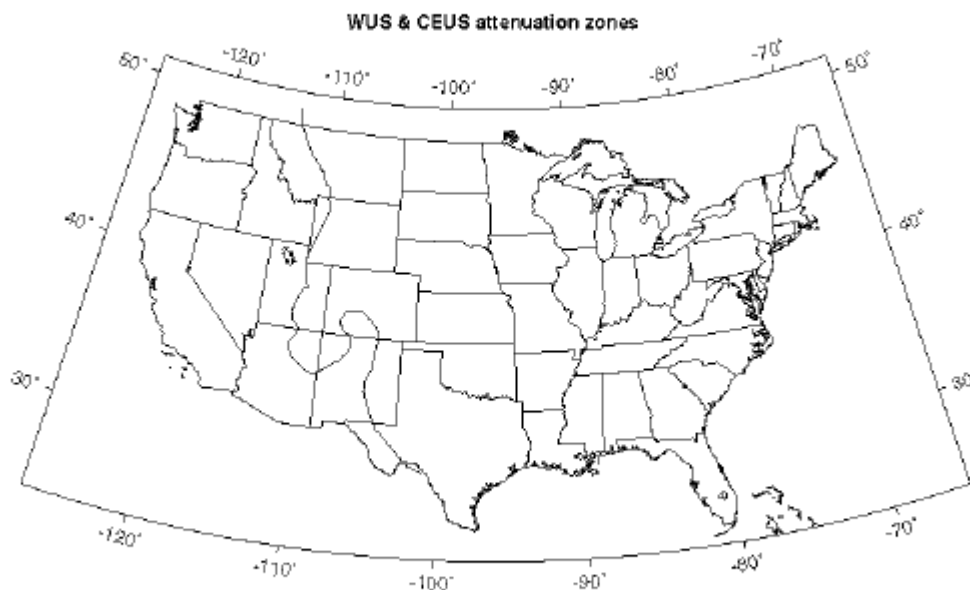
Time of most recent fault activity in parentheses after fault name: H = Holocene, LQ = Late Quaternary, MLQ = Middle to Late Quaternary, Q = Quaternary, LC = Late Cenozoic.

Demographic data from 2000 Census and Northeastern Colorado Emergency Managers hazard analysis ([www.ncem10.org/pdf/Local%20Hazards.pdf](http://www.ncem10.org/pdf/Local%20Hazards.pdf))

Historical earthquake data is from CGS Colorado Earthquake Information database, soon to be published as an interactive internet map server. Event identification numbers can be found in earthquake database table.

Inventory and HAZUS Risk are from scenarios performed in FEMA's Hazus-MH software. Deterministic scenarios were run for faults and counties to assess potential economic and social losses due to earthquake activity in Colorado. County inventories are the sum of building, transportation, and utility replacement default values in the Hazus data tables.

Default attenuation functions for the Western United States (WUS) and the Central United States (CEUS) were used for each scenario. These functions are taken from the USGS National Seismic Hazard Maps. The attenuation, or decrease in height of seismic waves over time, is greater in the WUS region. Seismic waves travel farther in the WUS. The inverse is true for the CEUS; however, the frequency of ground motion is greater for a given moment magnitude. This means a Mw 6.5 earthquake will be more damaging in the CEUS than the WUS. The results commonly show significant differences in losses between CEUS and WUS attenuation factors. This emphasizes the importance of determining what the Attenuation factor actually is in Colorado. Areas of Colorado fall in both the CEUS and WUS according to the figure below.



## **Adams County**

Population: 363,857

Growth since 1990: 37.3%

County Size: 1,198 square miles

Inventory: \$22,552.10 M

Faults within County: Rocky Mountain Arsenal (uncertain)

Historical Earthquakes: 1962 to 1972 Rocky Mountain Arsenal Earthquakes (#98-99, 103-105, 107-143, 145-147, 150-152, 154-188, 190-209, 219, 228-229, 233, 237, 239-241, 246-247, 251, 253-303, 305-306, 308-309, 311-327, 330-334, 336, 339-340, 342, 344-346, 348-350); June 10, 1978 NE of Denver (#363); Mar.-Sept. 1981 NE of Denver (#369-371); Mar.-Sept. 1982 NE of Denver (#374-375); Feb. 25, 1984 NE of Denver (#380); Nov. 8, 1989 NE Denver (#446)

Faults analyzed for County: Golden (Q), Rampart (MLQ), RM Arsenal, Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q)

Previous studies – perceived hazard: NCEM = 5

HAZUS losses per fault analyzed:

Golden Fault:	M6.5 Reverse WUS – 18 fatal, \$865 Million (-3.8%)
	M6.5 Normal CEUS – 68 fatal, \$2.37 Billion (-10.5%)
	M5.0 Reverse WUS – 0 fatal, \$33.7 Million (-0.15%)
Rampart Fault:	M7.0 Normal CEUS – 14 fatal, \$826 Million (3.7%)
RM Arsenal:	M6.5 CEUS – 317 fatal, \$6.69 Billion (-29.7%)
	M6.0 CEUS – 108 fatal, \$3.91 Billion (-17.3%)
	M5.5 CEUS – 10 fatal, \$1.56 Billion (-6.9%)
	M5.0 CEUS – 1 fatal, \$666 Million (-3.0%)
Ute Pass:	M7.0 CEUS – 5 fatal, \$500 Million (-2.2%)
Valmont:	M5.0 CEUS – 0 fatal, \$92.5 Million (-0.4%)
Walnut Creek:	M6.0 CEUS – 37 fatal, \$2.01 Billion (-8.9%)

## **Alamosa County**

Population: 14,966

Growth since 1990: 9.9%

County Size: 720 square miles

Inventory: \$1,918.73 M

Faults within County: Alamosa Horst Fault Zone East (LC), Alamosa Horst Fault Zone West (LC), Manassa (LC), North Sangre de Cristo (H)

Historical Earthquakes: Dec. 28, 2003 Blanca-Ft. Garland (#562-563)

Faults analyzed for County: N Sangre de Cristo (H)

Previous studies – perceived hazard: NCEM mentioned Rio Grande Rift

HAZUS Risk:

N Sangre:	M7.5 – 4 fatal, \$152.7 Million (-8.0%)
	M6.5 – 0 fatal, \$11.9 Million (-0.6%)
	M5.5 – 0 fatal, \$0.9 Million (-0.05%)

## **Arapahoe County**

Population: 487,967

Growth since 1990: 24.6%

County Size: 818 square miles

Inventory: \$35,003.30 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Golden (Q), Rampart (MLQ), RM Arsenal, Ute Pass (MLQ), Walnut Creek (Q)

Previous studies – perceived hazard: None

### HAZUS Risk:

Chase Gulch: M6.75 – 0 fatal, \$30.6 Million (-0.09%)  
Cheraw: M7.0 – 0 fatal, \$29.6 Million (-0.08%)  
Golden: M6.5 Reverse WUS – 38 fatal, \$1.4 Billion (-4.0%)  
M6.5 Normal CEUS – 48 fatal, \$2.14 Billion (-6.1%)  
M6.0 Reverse WUS – 4 fatal, \$444.5 Million (-1.3%)  
M5.5 Reverse WUS – 1 fatal, \$126 Million (-0.36%)  
M5.5 Normal CEUS – 1 fatal, \$406 Million (-1.15%)  
Rampart: M7.0 CEUS – 142 fatal, \$3.58 Billion (-10.2%)  
RM Arsenal: M6.5 CEUS – 52 fatal, \$2.36 Billion (-6.7%)  
Ute Pass: M7.0 CEUS – 35 fatal, \$1.60 Billion (-4.6%)  
Walnut Creek: M6.0 CEUS – 9 fatal, \$1.02 Billion (-2.9%)

### **Archuleta County**

Population: 9,898 Growth since 1990: 85.2%

County Size: 1,364 square miles Inventory: \$2,010.70 M

Faults within County: None

Historical Earthquakes: Feb. 12, 1882 Pagosa Springs (#6); May 12, 1882 Pagosa Springs (#7);  
Jan. 23, 1966 Dulce, NM (#210, 212-218, 220, 222-227)

Faults analyzed for County:

Previous studies – perceived hazard: NCEM = 100+

HAZUS Risk:

### **Baca County**

Population: 4,517 Growth since 1990: -0.9%

County Size: 2,565 square miles Inventory: \$1,853.90 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: 0

HAZUS Risk:

Cheraw: M7.0 CEUS – 0 fatal, \$5.74 Million (-0.3%)

### **Bent County**

Population: 9,898 Growth since 1990: 85.2%

County Size: 1,517 square miles Inventory: \$1,105.10 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: 0

HAZUS Risk:

Cheraw: M7.0 CEUS – 1 fatal, \$35.5 Million (-3.2%)

## **Boulder County**

Population: 291,288

Growth since 1990: 29.3%

County Size: 750 square miles

Inventory: \$23,607.40 M

Faults within County: Rock Creek (Q), Valmont (MLQ)

Historical Earthquakes: Oct. 12, 1916 Boulder (#29)

Faults analyzed for County: Frontal (LQ), Golden (Q), Mosquito (LQ), Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H)

Previous studies – perceived hazard: None

### HAZUS Risk:

Frontal:	M7.0 – 0 fatal, \$31.8 Million (-0.14%)
Golden:	M6.5 Reverse WUS – 41 fatal, \$1.44 Billion (-6.1%)
	M6.0 Reverse WUS – 5 fatal, \$467.5 Million (-2.0%)
	M5.5 Reverse WUS – 1 fatal, \$135 Million (-0.6%)
	M5.0 Reverse WUS – 0 fatal, \$33.5 Million (-0.14%)
Mosquito:	M7.0 – 0 fatal, \$31.7 Million (-0.13%)
Ute Pass:	M7.0 – 0 fatal, \$42.2 Million (-0.18%)
Valmont:	M5.0 – 1 fatal, \$256 Million (-1.1%)
Walnut Creek:	M6.0 CEUS – 42 fatal, \$2.14 Billion (-9.1%)
Williams Fork:	M6.75 – 0 fatal, \$29.3 Million (-0.12%)
	M6.5 – 0 fatal, \$18 Million (-0.08%)
	M6.0 – 0 fatal, \$4.8 Million (-0.02%)
	M5.5 – 0 fatal, \$0.2 Million (-0.00%)
1882 Earthquake:	M6.2 – 0 fatal, \$53.8 Million (-0.23%)

## **Chaffee County**

Population: 16,242

Growth since 1990: 28.1%

County Size: 1,039 square miles

Inventory: \$2,442.90 M

Faults within County: Buena Vista (Q), Missouri Park (LQ), North Sawatch (LQ), Northeastern Boundary Faults (MLQ), Poncha Pass (LC), Shavano Peak (Q), South Sawatch (H), Twin Lakes Faults (Q), Upper Arkansas Valley Faults (LC)

Historical Earthquakes: Nov. 15, 1901 Buena Vista (#20); Feb.-July, 1921 Garfield (#34-47); Dec. 19, 1966 Aspen (#242); July 20, 1987 Taylor Park (#435); Sept. 14, 1987 Winfield (#437); Aug. 4, 1994 Poncha Springs (#473)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H)

Previous studies – perceived hazard: NCEM = 100+

### HAZUS Risk:

Chase Gulch:	M6.75 – 0 fatal, \$8.9 Million (-0.36%)
	M6.0 – 0 fatal, \$1.8 Million (-0.07%)
Frontal:	M7.0 – 0 fatal, \$5.3 Million (-0.2%)
Mosquito:	M7.0 – 0 fatal, \$29.8 Million (-1.2%)
	M5.5 – 0 fatal, \$0.32 Million (-0.01%)
N Sangre:	M7.5 – 9 fatal, \$140 Million (-5.7%)
	M6.5 – 0 fatal, \$2.2 Million (-0.09%)

	M5.5 – 0 fatal, \$0.1 Million (-0.004%)
N Sawatch:	M7.0 – 6 fatal, \$150.4 Million (-6.2%)
	M6.5 – 0 fatal, \$27.6 Million (-1.1%)
	M6.0 – 0 fatal, \$6.7 Million (-0.3%)
	M5.5 – 0 fatal, \$1.7 Million (-0.07%)
S Sawatch:	M7.25 – 34 fatal, \$589 Million (-24.1%)
	M7.0 – 24 fatal, \$469 Million (-19.2%)
	M6.5 – 6 fatal, \$212 Million (-8.7%)
	M6.0 – 1 fatal, \$69.8 Million (-2.9%)
	M5.5 – 0 fatal, \$25 Million (-1.0%)

### **Cheyenne County**

Population: 2,231                      Growth since 1990: -6.9%  
County Size: 1,772 square miles      Inventory: \$1,463.30M  
Faults within County: High Plains Grabens under investigation  
Historical Earthquakes: July 6, 1989 Kit Carson (#445)  
Faults analyzed for County: Cheraw (H)  
Previous studies – perceived hazard: None  
HAZUS Risk:  
Cheraw:              M7.0 CEUS – 0 fatal, \$4.5 Million (-0.3%)

### **Clear Creek County**

Population: 9,322                      Growth since 1990: 22.4%  
County Size: 394 square miles      Inventory: \$1,696.90 M  
Faults within County: Floyd Hill (LC), Kennedy Gulch (LC)  
Historical Earthquakes: Nov. 9, 1871 Georgetown (#3); 1881 Georgetown (#5); Aug. 5, 1894 Georgetown (#16)  
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), N Sawatch (LQ), Ute Pass (MLQ), Williams Fork (H)  
Previous studies – perceived hazard: None  
HAZUS Risk:  
Chase Gulch:              M6.75 – 0 fatal, \$3.9 Million (-0.2%)  
Frontal:                      M7.0 – 0 fatal, \$13.3 Million (-0.8%)  
                                    M5.5 – 0 fatal, \$0.4 Million (-0.02%)  
Golden:                      M6.5 – 0 fatal, \$24.3 Million (-1.4%)  
Mosquito:                   M7.0 – 0 fatal, \$13.6 Million (-0.8%)  
N Sawatch:                  M7.0 – 0 fatal, \$1.6 Million (-0.09%)  
Ute Pass:                    M7.0 – 0 fatal, \$3.0 Million (-0.18%)  
Williams Fork:              M6.75 – 0 fatal, \$13 Million (-0.77%)  
                                    M6.0 – 0 fatal, \$1.5 Million (-0.08%)

### **Conejos County**

Population: 8,400                      Growth since 1990: 12.7%  
County Size: 1,269 square miles      Inventory: \$1,192.20 M  
Faults within County: Conejos River Faults (LC), Cumbres (LC), La Jara Reservoir (LC), Los Mogotes Volcano Faults (LC)

Historical Earthquakes: Oct. 7, 1952 Antonito (#82)

Faults analyzed for County: N Sangre de Cristo (H)

Previous studies – perceived hazard: NCEM mentioned Rio Grande Rift

HAZUS Risk:

N Sangre: M7.5 – 0 fatal, \$10.9 Million (-0.9%)

### **Costilla County**

Population: 3,663

Growth since 1990: 14.8%

County Size: 1,215 square miles

Inventory: \$1,027.46 M

Faults within County: Alvarado (LC), Culebra Range Faults (LC), Garcia (LQ), La Veta Faults (LC), Mesita (LQ), N Basaltic Hills Faults (Q), N Sangre de Cristo (H), S Sangre de Cristo-San Pedro Mesa Section (LQ)

Historical Earthquakes: Dec. 28, 2003 Blanca-Ft. Garland (#562-563)

Faults analyzed for County: N Sangre de Cristo (H)

Previous studies – perceived hazard: NCEM mentioned Rio Grande Rift

HAZUS Risk:

N Sangre: M7.5 – 4 fatal, \$89.5 Million (-8.7%)

M7.0 – 0 fatal, \$6.8 Million (-0.7%)

M6.5 – 0 fatal, \$1.5 Million (-0.15%)

M5.5 – 0 fatal, \$0.1 Million (-0.01%)

### **Crowley County**

Population: 5,518

Growth since 1990: 39.8%

County Size: 803 square miles

Inventory: \$683.25 M

Faults within County: Cheraw (H)

Historical Earthquakes: Dec. 4, 1870 Pueblo-Ft. Reynolds (#1); Nov. 28, 1955 Fowler-Sugar City (#88)

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Cheraw: M7.0 CEUS – 3 fatal, \$60.5 Million (-8.9%)

M5.5 CEUS – 0 fatal, \$4 Million (-0.6%)

### **Custer County**

Population: 3,503

Growth since 1990: 81.9%

County Size: 737 square miles

Inventory: \$906.60 M

Faults within County: Alvarado (LC), Dead Mule Gulch (LC), Ilse (LC), Johnson Gulch (LC), Rosita (LC), Round Mountain (LC), Silver Cliff Graben (LC), Westcliffe (LC), Wet Mountain (LC)

Historical Earthquakes: Oct. 23, 1888 Wet Mountains (#12); Feb. 18, 1925 Wetmore (#52)

Faults analyzed for County: Goodpasture (Q), N Sangre de Cristo (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Goodpasture: M6.0 – 0 fatal, \$0.95 Million (-0.1%)

N Sangre: M7.5 – 3 fatal, \$72.5 Million (-8.0%)

M6.5 – 0 fatal, \$12.2 Million (-1.4%)  
M5.5 – 0 fatal, \$1.8 Million (-0.2%)

### **Delta County**

Population: 27,834

Growth since 1990: 32.7%

County Size: 1,157 square miles

Inventory: \$2,960.50 M

Faults within County: Bridgeport (Q), Escalante (Q), Little Dominguez Creek (Q)

Historical Earthquakes: Sept. 9, 1944 Montrose-Basalt (#75-border); Jan. 12, 1967 Somerset (#243-border); Sept. 26, 1994 Somerset Coal Bump (#479); Nov. 2, 1994 Somerset Coal Bump (#480); Jan. 1, 1995 Somerset Coal Bump (#483); Mar. 14, 1995 Somerset Coal Bump (#485); Nov. 5, 2001 Paonia-Somerset (#533); Dec. 4, 2001 Paonia-Somerset (#534); Mar.-Apr. 2002 Paonia-Somerset (#538-540); June-Dec. 2002 Paonia-Somerset (#543, 546-549, 551-552); Jan.-Aug. 2003 Paonia-Somerset (#555, 557-558)

Faults analyzed for County: Cimarron (LQ, Q), Roubideau Creek (H)

Previous studies – perceived hazard: None

#### HAZUS Risk:

Cimarron: M6.75 – 0 fatal, \$18 Million (-0.6%)  
M6.0 – 0 fatal, \$2.9 Million (-0.09%)  
Roubideau: M5.5 Normal – 0 fatal, \$1.7 Million (-0.06%)  
M5.5 Reverse – 0 fatal, \$3.2 Million (-0.1%)  
M5.0 Normal – 0 fatal, \$0.4 Million (-0.01%)  
M5.0 Reverse – 0 fatal, \$0.8 Million (-0.03%)

### **Denver City and County**

Population: 554,636

Growth since 1990: 18.6%

County Size: 155 square miles

Inventory: \$40,159.30 M

Faults within County: None

Historical Earthquakes: Dec. 29, 1901 Denver (#21); Jan. 27, 1923 Denver (#49); Jan. 4, 1924 Denver (#50); June 5, 1963 RM Arsenal (#140); Numerous 1960's RM Arsenal shocks NE of Denver

Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), RM Arsenal, N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H)

Previous studies – perceived hazard: NCEM = 50

#### HAZUS Risk:

Chase Gulch: M6.75 WUS – 0 fatal, \$39.6 Million (-0.1%)  
M6.75 CEUS – 4 fatal, \$523 Million (-1.3%)  
Cheraw: M7.0 CEUS and WUS - \$0 – cannot 'reach'  
Frontal: M7.0 WUS – 0 fatal, \$39.2 Million (-0.1%)  
Golden: M6.5 Reverse WUS – 114 fatal, \$3.24 Billion (-8.1%)  
M6.5 Normal CEUS – 164 fatal, \$4.73 Billion (-11.8%)  
M6.0 Reverse WUS – 17 fatal, \$1.20 Billion (-3.0%)  
M6.0 Normal CEUS – 41 fatal, \$2.57 Billion (-6.4%)  
M5.5 Reverse WUS – 2 fatal, \$374 Million (-0.93%)

	M5.5 Normal CEUS – 5 fatal, \$1.03 Billion (-2.6 %)
	M5.0 Reverse WUS – 0 fatal, \$98.3 Million (-0.25%)
	M5.0 Normal CEUS – 0 fatal, \$325 Million (-0.8%)
Mosquito:	M7.0 WUS – 0 fatal, \$38.1 Million (-0.09%)
Rampart:	M7.0 WUS – 6 fatal, \$569 Million (-1.4%)
	M7.0 CEUS – 99 fatal, \$3.19 Billion (-8.0%)
	M6.5 WUS – 1 fatal, \$129 Million (-0.3%)
	M6.5 CEUS – 6 fatal, \$737 Million (-1.8%)
	M6.0 CEUS – 1 fatal, \$194 Million (-0.5%)
	M5.5 CEUS – 0 fatal, \$37.0 Million (-0.09%)
RM Arsenal:	M6.5 CEUS – 201 fatal, \$5.18 Billion (-12.9%)
	M5.5 CEUS – 6 fatal, \$1.13 Billion (-2.8%)
N Sangre:	M7.5 WUS – 0 fatal, \$29.9 Million (-0.07%)
	M7.5 CEUS – 8 fatal, \$593 Million (-1.5%)
	M7.0 WUS – 0 fatal, \$8.0 Million (-0.02%)
	M6.5 WUS - \$0 – cannot ‘reach’
	M6.5 CEUS – 0 fatal, \$5.0 Million (-0.01%)
N Sawatch:	M7.0 WUS – 0 fatal, \$15.5 Million (-0.04%)
	M7.0 CEUS – 2 fatal, \$298 Million (-0.74%)
S Sawatch:	M7.25 WUS – 0 fatal, \$18.7 Million (-0.05%)
	M7.25 CEUS – 4 fatal, \$422 Million (-1.05%)
Ute Pass:	M7.0 CEUS – 27 fatal, \$1.59 Billion (-4.0%)
	M5.5 CEUS – 0 fatal, \$22 Million (-0.06%)
Valmont:	M5.0 WUS – 0 fatal, \$10.3 Million (-0.03%)
	M5.0 CEUS – 0 fatal, \$47.4 Million (-0.12%)
Walnut Creek:	M6.0 CEUS – 50 fatal, \$2.80 Billion (-7.0%)
Williams Fork:	M6.75 WUS – 0 fatal, \$24.5 Million (-0.06%)
1882 Earthquake:	M6.2 WUS – 0 fatal, \$13.1 Million (-0.03%)
	M6.2 CEUS – 1 fatal, \$111.8 Million (-0.3%)

### **Dolores County**

Population: 1,844

Growth since 1990: 22.6%

County Size: 1,028 square miles

Inventory: \$526.70 M

Faults within County: None

Historical Earthquakes: Feb. 12, 1967 Rico (#248); Sept. 9, 1987 Rico (#436)

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

### **Douglas County**

Population: 175,766

Growth since 1990: 191%

County Size: 843 square miles

Inventory: \$14,771.27 M

Faults within County: Kennedy Gulch (LC), Oil Creek (LC), Perry Park-Jarre Canyon (LC), Rampart Range (MLQ), Ute Pass (MLQ)

Historical Earthquakes: Sept. 14, 1965 S of Denver (#189); Dec. 25, 1994 Palmer Lake (#482)

Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Frontal (LQ), Golden (Q), Rampart (MLQ), N Sawatch (LQ), Ute Pass (MLQ)

Previous studies – perceived hazard: NCEM = 100+

HAZUS Risk:

Chase Gulch:	M6.75 WUS – 0 fatal, \$15.3 Million (-0.1%)
Cheraw:	M7.0 CEUS – 0 fatal, \$32.3 Million (-0.22%)
Frontal:	M7.0 WUS – 0 fatal, \$10.0 Million (-0.07%)
Golden:	M6.5 Reverse WUS – 4 fatal, \$323.4 Million (-2.2%) M6.5 Normal CEUS – 5 fatal, \$484.6 Million (-3.3%) M5.5 Reverse WUS – 0 fatal, \$28.7 Million (-0.2%) M5.5 Normal CEUS – 0 fatal, \$6.5 Million (-0.04%)
Rampart:	M7.0 WUS – 59 fatal, \$906.5 Million (-6.1%) M7.0 CEUS – 145 fatal, \$2.84 Billion (-19.2%) M6.5 WUS – 10 fatal, \$231 Million (-1.6%) M6.5 CEUS – 33 fatal, \$901.4 Million (-6.1%) M6.0 WUS – 1 fatal, \$61.4 Million (-0.4%) M6.0 CEUS – 4 fatal, \$280.8 Million (-1.9%) M5.5 CEUS – 0 fatal, \$81.6 Million (-0.55%)
N Sawatch:	M7.0 WUS – 0 fatal, \$4.8 Million (-0.03%)
Ute Pass:	M7.0 WUS – 10 fatal, \$292.6 Million (-1.8%) M7.0 CEUS – 41 fatal, \$1.15 Billion (-7.8%) M6.5 WUS – 1 fatal, \$83.2 Million (-0.56%) M6.5 CEUS – 5 fatal, \$346 Million (-2.3%) M5.5 WUS – 0 fatal, \$6.2 Million (-0.04%) M5.5 CEUS – 0 fatal, \$26 Million (-0.2%)

**Eagle County**

Population: 41,659                      Growth since 1990: 90.0%

County Size: 1,685 square miles      Inventory: \$5,287.90 M

Faults within County: Basalt Mountain (LC), Burns Faults (MLQ), Dotsero Faults (LC), Frontal (LQ), Gore (LC), Greenhorn Mountain (Q), Gypsum Faults (LC), Leadville (Q), Red Hill Faults (Q)

Historical Earthquakes: Apr. 3, 1946 Riland (#80); May 30, 1965 Tennessee Pass (#161); Apr. 3, 1966 South Park Blast (#221-border); Sept. 12, 1990 Vail (#449)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Williams Fork (H)

Previous studies – perceived hazard: NCEM mentioned a 1957 Gilman earthquake (?)

HAZUS Risk:

Chase Gulch:	M6.75 – 0 fatal, \$4.3 Million (-0.08%)
Frontal:	M7.0 – 11 fatal, \$268 Million (-5.1%) M6.5 – 4 fatal, \$137.5 Million (-2.6%) M6.0 – 1 fatal, \$50.7 Million (-1.0%) M5.5 – 0 fatal, \$15.3 Million (-0.3%)
Mosquito:	M7.0 – 6 fatal, \$172.7 Million (-3.3%) M5.5 – 0 fatal, \$5.4 Million (-0.1%)
N Sangre:	M7.5 – 0 fatal, \$4.2 Million (-0.08%)

N Sawatch:	M7.0 – 5 fatal, \$160 Million (-3.0%)
	M6.5 – 0 fatal, \$40 Million (-0.75%)
	M6.0 – 0 fatal, \$10 Million (-0.2%)
	M5.5 – 0 fatal, \$2.5 Million (-0.04%)
S Sawatch:	M7.25 – 0 fatal, \$36.2 Million (-0.7%)
	M7.0 – 0 fatal, \$15.7 Million (-0.3%)
	M6.0 – 0 fatal, \$1.0 Million (-0.02%)
Williams Fork:	M6.75 – 1 fatal, \$75.6 Million (-1.4%)
	M6.5 – 0 fatal, \$54.4 Million (-1.0%)
	M6.0 – 0 fatal, \$19.1 Million (-0.36%)
	M5.5 – 0 fatal, \$5.8 Million (-0.11%)

## **El Paso County**

Population: 516,929

Growth since 1990: 30.2%

County Size: 2,158 square miles

Inventory: \$34,663.34 M

Faults within County: Colorado Springs Faults (LC), Rampart Range (MLQ), Ute Pass (MLQ)

Historical Earthquakes: Dec. 23 and 31, 1995 Manitou Springs (#492, 493); Jan. 1997

Woodland Park (#497-499); Apr. 18, 1998 Woodland Park (#503); July 22, 2001 Woodland Park (#515); Feb. 19, 2003 Woodland Park (#556)

Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Goodpasture (Q), Rampart (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)

Previous studies – perceived hazard: NCEM mentioned July 22, 2001 event

### HAZUS Risk:

Chase Gulch:	M6.75 WUS – 0 fatal, \$56.2 Million (-0.16%)
	M6.75 CEUS – 3 fatal, \$494.6 Million (-1.4%)
Cheraw:	M7.0 CEUS – 2 fatal, \$317.6 Million (-9.2%)
	M5.5 CEUS – 0 fatal, \$5.5 Million (-0.02%)
Goodpasture:	M6.0 WUS – 0 fatal, \$11.6 Million (-0.03%)
Rampart:	M7.0 WUS – 596 fatal, \$8.15 Billion (-23.5%)
	M7.0 CEUS – 114 fatal, \$3.46 Billion (-10.0%)
	M6.5 WUS – 111 fatal, \$2.83 Billion (-8.2%)
	M6.5 CEUS – 75 fatal, \$3.0 Billion (-8.7%)
	M6.0 WUS – 12 fatal, \$832 Million (-2.4%)
	M6.0 CEUS – 22 fatal, \$1.77 Billion (-5.1%)
	M5.5 WUS – 1 fatal, \$244 Million (-0.7%)
	M5.5 CEUS – 3 fatal, \$753 Million (-2.2%)
N Sangre:	M7.5 WUS – 0 fatal, \$79.6 Million (-0.2%)
	M6.5 WUS – 0 fatal, \$9.5 Million (-0.03%)
	M5.5 WUS – 0 fatal, \$0.01 Million (-0.00%)
S Sawatch:	M7.25 WUS – 0 fatal, \$29.7 Million (-0.09%)
Ute Pass:	M7.0 WUS – 577 fatal, \$7.92 Billion (-22.9%)
	M7.0 Reverse WUS – 678 fatal, \$9.30 Billion (-26.8%)
	M7.0 CEUS – 173 fatal, \$4.49 Billion (-13.0%)
	M6.5 WUS – 144 fatal, \$3.30 Billion (-9.5%)
	M6.5 CEUS – 111 fatal, \$3.81 Billion (-11.0%)
	M6.0 WUS – 16 fatal, \$988 Million (-2.9%)

M6.0 CEUS – 33 fatal, \$2.24 Billion (-6.5%)  
M5.5 WUS – 2 fatal, \$282.6 Million (-0.8%)  
M5.5 CEUS – 4 fatal, \$940 Million (-2.7%)

### **Elbert County**

Population: 19,872                      Growth since 1990: 106.0%  
County Size: 1,865 square miles      Inventory: \$2,525.50 M  
Faults within County: None  
Historical Earthquakes: Oct. 13, 1966 E of Castle Rock (#236)  
Faults analyzed for County: Cheraw (H), Rampart (MLQ), Ute Pass (MLQ)  
Previous studies – perceived hazard: None  
HAZUS Risk:  
    Cheraw:            M7.0 CEUS – 0 fatal, \$7.7 Million (-0.3%)  
    Rampart:          M7.0 CEUS – 4 fatal, \$151.1 Million (-6.0%)  
    Ute Pass:          M7.0 CEUS – 1 fatal, \$69.9 Million (-2.8%)

### **Fremont County**

Population: 46,145                      Growth since 1990: 43.0%  
County Size: 1,562 square miles      Inventory: \$3,931.00 M  
Faults within County: Alvarado (LC), Bare Hills (LC), Box Canyon and Quarry Faults (LC), Coaldale-Wellsville (LC), Currant Creek (LC), Dead Mule Gulch (LC), Fourmile Creek (LC), High Park (LC), Iron Mountain (LC), Isle (LC), Parkdale Faults (LC), Pleasant Valley (LC), Rice Mountain (LC), Salida South (LC), Tanner Peak (LC), Texas Creek (LC), Thompson Mountain (LC), Westcliffe (LC), Wet Mountain (LC)  
Historical Earthquakes: Mar. 16, 1985 Salida (#402); Apr. 16, 1987 Howard (#434)  
Faults analyzed for County: Chase Gulch (LQ), Goodpasture (Q), Rampart (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)  
Previous studies – perceived hazard: NCEM mentioned two unnamed earthquakes  
HAZUS Risk:  
    Chase Gulch: M6.75 – 0 fatal, \$15.4 Million (-0.4%)  
    Goodpasture: M6.0 – 0 fatal, \$6.9 Million (-0.17%)  
    Rampart:        M7.0 – 0 fatal, \$28.6 Million (-0.7%)  
    N Sangre:      M7.5 – 5 fatal, \$125.4 Million (-3.2%)  
                      M6.5 – 0 fatal, \$7.6 Million (-0.2%)  
                      M5.5 – 0 fatal, \$0.5 Million (-0.00%)  
    S Sawatch:    M7.25 – 0 fatal, \$19.5 Million (-0.5%)  
    Ute Pass:      M7.0 – 1 fatal, \$51.5 Million (-1.3%)

### **Garfield County**

Population: 43,791                      Growth since 1990: 46.1%  
County Size: 2,994 square miles      Inventory: \$4,936.40 M  
Faults within County: Canyon Creek (LC), Causeway (LC), Consolidated Reservoir (LC), Grand Hogback Faults-Freeman Creek (Q), Grand Hogback-Fourmile Creek (H), Grand Hogback-SW Glenwood (LQ), Grand Hogback Faults-SW Glenwood (LC), Heuschkel Park Faults (LC),

Lookout Mountain Faults (LC), Missouri Heights Faults (LC), Possum Creek (LC), Red Canyon (LC), Spring Valley Faults (LC), West Coal Creek (LC)

Historical Earthquakes: Jan. 15, 1889 Glenwood Springs (#13); Dec. 21, 1906 New Castle (#24); Dec. 29-30, 1920 New Castle (#30-33); Jan. 31, 1946 Glenwood Springs (#79); Sept. 10, 1969 Rulison AEC Test (#329); Jan. 7, 1971 Glenwood Springs (#341); Nov. 22, 1982 Rifle (#376); Apr.-May 1984 Carbondale Earthquakes (#381-399); Oct. 19, 1990 New Castle (#450-451); Dec. 12, 1990 New Castle (#453); Mar. 8, 1994 Douglas Pass (#472); Dec. 5, 2000 Carbondale (#514); Aug. 2001 Glenwood Springs Earthquakes (#516-519); Mar. 19, 2002 Douglas Pass (#536)

Faults analyzed for County: Frontal (LQ), N Sawatch (LQ)

Previous studies – perceived hazard: NCEM = 10, mentioned 1982 Carbondale earthquakes

HAZUS Risk:

Frontal:	M7.0 – 0 fatal, \$3.3 Million (-0.07%)
N Sawatch:	M7.0 – 0 fatal, \$8.8 Million (-0.2%)
	M6.0 – 0 fatal, \$0.5 Million (-0.009%)

### **Gilpin County**

Population: 4,757 Growth since 1990: 55.0%

County Size: 149 square miles Inventory: \$764.40 M

Faults within County: Floyd Hill Fault Zone (LC)

Historical Earthquakes: None

Faults analyzed for County: Frontal (LQ), Golden (Q), Williams Fork (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Frontal:	M7.0 – 0 fatal, \$3.4 Million (-0.45%)
Golden:	M6.5 Reverse – 0 fatal, \$24.5 Million (-3.2%)
	M5.5 Reverse – 0 fatal, \$2.8 Million (-0.4%)
Williams Fork:	M6.75 – 0 fatal, \$3.5 Million (-0.5%)

### **Grand County**

Population: 12,442 Growth since 1990: 56.2%

County Size: 1,840 square miles Inventory: \$3,255.70 M

Faults within County: Antelope Pass (LC), Barger Gulch (LC), Gore (LC), Granby Basin Faults (LC), Granby Faults West (LC), Kremmling Faults West (LC), Laramie River (LC), Parshall (LC), Rabbit Ears Pass Faults (LC), Rabbit Ears Range (LC), Sheephorn Mountain Faults (LC), Trail Ridge (LC), Troublesome Creek (LC), Williams Fork Mountains (H), Williams Fork Valley Faults (MLQ), Williams Fork Valley Faults East (LC)

Historical Earthquakes: Aug. 4, 1964 Dillon (#149)

Faults analyzed for County: Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), Williams Fork (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Frontal:	M7.0 – 0 fatal, \$52.5 Million (-1.6%)
	M5.5 – 0 fatal, \$1.1 Million (-0.03%)
Mosquito:	M7.0 – 0 fatal, \$16.9 Million (-0.5%)
	M5.5 – 0 fatal, \$0.2 Million (-0.00%)
N Sawatch:	M7.0 – 0 fatal, \$3.6 Million (-0.1%)

Williams Fork: M6.75 – 1 fatal, \$77.3 Million (-2.4%)  
M6.5 – 0 fatal, \$45.2 Million (-1.4%)  
M6.0 – 0 fatal, \$13.1 Million (-0.4%)  
M5.5 – 0 fatal, \$3.8 Million (-0.1%)

### **Gunnison County**

Population: 13,956 Growth since 1990: 35.9%

County Size: 3,238 square miles Inventory: \$2,782.40 M

Faults within County: Cimarron (Q, LQ, LC), Red Rocks (Q), Treasure Mountain (LC)

Historical Earthquakes: July 1886 Cimarron (#11); Sept. 9, 1944 Montrose-Basalt (#75); Oct. 12, 1960 Montrose-Ridgway (#93); Sept. 4, 1966 Cimarron Ridge (#234); Jan. 12, 1967 Somerset (#243); Aug. 14, 1983 Cimarron (#377); Apr.-Oct. 1986 Crested Butte Earthquakes (#404-430, 432-433); Dec. 26, 1991 Powderhorn (#460-461); Sept. 26, 1994 Somerset Coal Bump (#479); Nov. 2, 1994 Somerset Coal Bump (#480); Jan. 1, 1995 Somerset Coal Bump (#483); Mar. 14, 1995 Somerset Coal Bump (#485); Nov. 5, 2001 Paonia-Somerset (#533); Dec. 4, 2001 Paonia-Somerset (#534); Mar.-Apr. 2002 Paonia-Somerset (#538-540); June-Dec. 2002 Paonia-Somerset (#543, 546-549, 551-552); Jan.-Aug. 2003 Paonia-Somerset (#555, 557-558)

Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H)

Previous studies – perceived hazard: None

#### HAZUS Risk:

Busted Boiler:	M6.5 – 0 fatal, \$1.3 Million (-0.05%)
Cannibal:	M7.0 – 0 fatal, \$12.2 Million (-0.44%)
Cimarron:	M6.75 – 0 fatal, \$13.5 Million (-0.5%)
	M6.5 – 0 fatal, \$8.5 Million (-0.3%)
	M6.0 – 0 fatal, \$2.5 Million (-0.08%)
	M5.5 – 0 fatal, \$0.6 Million (-0.00%)
Roubideau Cr.:	M5.5 Normal – 0 fatal, \$0.01 Million (-0.00%)
	M5.5 Reverse – 0 fatal, \$0.02 Million (-0.00%)
N Sangre:	M7.5 – 0 fatal, \$3.95 Million (-0.14%)
N Sawatch:	M7.0 – 0 fatal, \$9.3 Million (-0.3%)
	M6.0 – 0 fatal, \$1.1 Million (-0.03%)
S Sawatch:	M7.25 – 0 fatal, \$17.9 Million (-0.6%)
	M6.75 – 0 fatal, \$5.9 Million (-0.2%)
	M6.0 – 0 fatal, \$1.0 Million (-0.03%)

### **Hinsdale County**

Population: 790 Growth since 1990: 69.2%

County Size: 1,057 square miles Inventory: \$360.30 M

Faults within County: Cannibal (LQ), Lake City Caldera Faults (LC)

Historical Earthquakes: Aug. 3, 1955 Lake City (#85-87)

Faults analyzed for County: Busted Boiler (H), Cannibal (LQ)

Previous studies – perceived hazard: None

#### HAZUS Risk:

Busted Boiler:	M6.5 – 0 fatal, \$0.4 Million (-0.11%)
Cannibal:	M7.0 – 0 fatal, \$19.4 Million (-5.4%)

M6.0 – 0 fatal, \$3.7 Million (-1.0%)

### **Huerfano County**

Population: 7,862

Growth since 1990: 30.8%

County Size: 1,578 square miles

Inventory: \$1,983.50 M

Faults within County: Alvarado (LC), Bear Creek (LC), Farista Faults (LC), Greenhorn (LC), Ilse (LC), La Veta Faults West (LC), Westcliffe (LC), Wet Mountains South (LC)

Historical Earthquakes: None

Faults analyzed for County: Goodpasture (Q), N Sangre de Cristo (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Goodpasture: M6.0 – 0 fatal, \$3.7 Million (-0.18%)

N Sangre: M7.5 – 0 fatal, \$37.8 Million (-1.9%)

M6.5 – 0 fatal, \$2.3 Million (-0.1%)

### **Jackson County**

Population: 1,577

Growth since 1990: -1.7%

County Size: 1,622 square miles

Inventory: \$960.70 M

Faults within County: Arapahoe Ridge Faults (LC), East Independence Mountain (LC), North Park Faults NW and W (LC), Park Range Faults (LC), Rabbit Ears Range (LC), Sierra Madre Range Faults (LC), Spring Creek (LC), Trail Ridge (LC), Walden Faults (LC), West Independence Mountain (LC)

Historical Earthquakes: Oct. 3, 1948 Walden (#81)

Faults analyzed for County: Frontal (LQ), Williams Fork (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Frontal: M7.0 – 0 fatal, \$0.95 Million (-0.1%)

Williams Fork: M6.75 – 0 fatal, \$0.78 Million (-0.08%)

### **Jefferson County**

Population: 527,056

Growth since 1990: 20.2%

County Size: 785 square miles

Inventory: \$37,521.70 M

Faults within County: Floyd Hill (LC), Golden (Q), Ken Caryl (LC), Kennedy Gulch (LC), Rock Creek (Q), Walnut Creek (Q)

Historical Earthquakes: Jan. 5, 1965 Rocky Flats (#153); Feb. 16, 1965 N of Denver (#155); Sept. 29, 1965 N of Denver (#192); 1960's-70's RM Arsenal Earthquakes; Nov.-Dec. 1981 Conifer (#372-373); Sept. 21, 1986 Conifer (#431)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), N Sangre de Cristo (H), N Sawatch (LQ), Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H)

Previous studies – perceived hazard: NCEM = 10, mentioned two faults and 1960's swarm

HAZUS Risk:

Chase Gulch: M6.75 – 0 fatal, \$59.8 Million (-0.16%)

Frontal: M7.0 – 0 fatal, \$57.4 Million (-0.15%)

Golden:	M6.5 CEUS – 322 fatal, \$8.14 Billion (-21.7%) M6.5 Reverse – 328 fatal, \$6.81 Billion (-18.2%) M6.5 Normal – 290 fatal, \$5.97 Billion (-15.9%) M6.0 Reverse – 91 fatal, \$3.20 Billion (-8.5%) M5.5 CEUS – 11 fatal, \$2.06 Billion (-5.5%) M5.5 Reverse – 10 fatal, \$1.08 Billion (-2.9%) M5.0 Reverse – 2 fatal, \$385 Million (-1.0%)
Mosquito:	M7.0 – 0 fatal, \$53.7 Million (-0.14%)
Rampart:	M7.0 – 3 fatal, \$400.3 Million (-1.1%) M6.0 – 0 fatal, \$23.3 Million (-0.06%)
N Sangre de Cristo:	M7.5 – 0 fatal, \$30.5 Million (-0.08%)
N Sawatch:	M7.0 – 0 fatal, \$18.2 Million (-0.05%)
Ute Pass:	M7.0 – 2 fatal, \$246 Million (-0.7%)
Valmont:	M5.0 – 0 fatal, \$23.9 Million (-0.06%)
Walnut Creek:	M6.0 CEUS – 108 fatal, \$4.71 Billion (-12.6%)
Williams Fork:	M6.75 – 0 fatal, \$36.4 Million (-0.09%) M5.5 – 0 fatal, \$0.06 Million (-0.00%)

### **Kiowa County**

Population: 1,622                      Growth since 1990: -3.9%  
County Size: 1,792 square miles    Inventory: \$1,149.24 M  
Faults within County: Cheraw (H)  
Historical Earthquakes: Oct. 15, 1921 Eads (#48); Jan. 10, 2003 Lamar (#554)  
Faults analyzed for County: Cheraw (H)  
Previous studies – perceived hazard: None  
HAZUS Risk:  
Cheraw:            M7.0 – 0 fatal, \$5.1 Million (-0.45%)  
                         M5.5 – 0 fatal, \$0.5 Million (-0.04%)

### **Kit Carson County**

Population: 8,011                      Growth since 1990: 12.2%  
County Size: 2,171 square miles    Inventory: \$2,287.90 M  
Faults within County: High Plains Grabens under investigation  
Historical Earthquakes: May 27, 1984 Burlington (#400)  
Faults analyzed for County:  
Previous studies – perceived hazard: None  
HAZUS Risk:

### **La Plata County**

Population: 43,941                      Growth since 1990: 36.1%  
County Size: 1,685 square miles    Inventory: \$4,675.20 M  
Faults within County: None  
Historical Earthquakes: Aug. 29, 1941 Durango-Bayfield (#72)  
Faults analyzed for County: Busted Boiler (H), Cimarron (LQ,Q)  
Previous studies – perceived hazard: None

### HAZUS Risk:

Busted Boiler: M6.5 – 0 fatal, \$3.9 Million (-0.08%)

Cimarron: M6.75 – 0 fatal, \$2.4 Million (-0.05%)

### **Lake County**

Population: 7,812

Growth since 1990: 30.0%

County Size: 380 square miles

Inventory: \$1,135.60 M

Faults within County: Leadville-NW and S (Q), Mosquito (LQ), North Sawatch (LQ), Northeastern Boundary Faults (MLQ), Sawatch Range Faults (LC), Twin Lakes Reservoir Faults (Q)

Historical Earthquakes: May 23, 1964 Blast at Climax (#148); May 30, 1965 Tennessee Pass (#161)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), S Sawatch (H)

Previous studies – perceived hazard: None

### HAZUS Risk:

Chase Gulch: M6.75 – 0 fatal, \$2.7 Million (-0.2%)

Frontal: M7.0 – 0 fatal, \$18.8 Million (-1.7%)

M5.5 – 0 fatal, \$0.4 Million (-0.04%)

Mosquito: M7.0 – 4 fatal, \$117.2 Million (-10.3%)

M6.5 – 1 fatal, \$52.1 Million (-4.6%)

M6.0 – 0 fatal, \$15.2 Million (-1.3%)

M5.5 – 0 fatal, \$4.5 Million (-0.4%)

N Sawatch: M7.0 – 6 fatal, \$155.1 Million (-13.7%)

M6.5 – 3 fatal, \$104.0 Million (-9.2%)

M6.0 – 1 fatal, \$53.4 Million (-4.7%)

M5.5 – 0 fatal, \$23.5 Million (-2.1%)

S Sawatch: M7.25 – 2 fatal, \$67.6 Million (-6.0%)

M7.0 – 0 fatal, \$28.8 Million (-2.5%)

M6.5 – 0 fatal, \$6.4 Million (-0.6%)

M6.0 – 0 fatal, \$1.5 Million (-0.1%)

### **Larimer County**

Population: 251,494

Growth since 1990: 35.1%

County Size: 2,614 square miles

Inventory: \$19,684.70 M

Faults within County: Larimer River (LC), Larimer River Valley (LC), Trail Ridge (LC)

Historical Earthquakes: Nov. 8, 1882 North-Central Colorado (#8); Sept. 9, 1903 Estes Park (#22); Oct. 3, 1948 Walden (#81); Nov. 3, 1977 Poudre Canyon (#361)

Faults analyzed for County: Golden (Q), Valmont (MLQ), Williams Fork (H)

Previous studies – perceived hazard: None

### HAZUS Risk:

Golden: M6.5 – 0 fatal, \$51 Million (-0.26%)

Valmont: M5.0 – 0 fatal, \$2.3 Million (-0.01%)

Williams Fork: M6.75 – 0 fatal, \$9.0 Million (-0.04%)

M5.5 – 0 fatal, \$0.13 Million (-0.00%)

### **Las Animas County**

Population: 15,207

Growth since 1990: 10.5%

County Size: 4,794 square miles

Inventory: \$3,783.60 M

Faults within County: La Veta Faults West (LC)

Historical Earthquakes: Oct. 3, 1966 NE of Trinidad (#235); Sept. 1973 Valdez-Boncarbo (#352-356); May 30, 1976 Pinon Canyon Area (#359); Aug. 17, 1983 NE of Trinidad (#378); Mar. 24, 1989 Mesa de Maya (#442); Apr. 15, 1992 Aguilar (#462); May 2, 1992 Gulnare (#463); Aug. 1, 1996 Tyrone (#494-495); Nov. 1, 1996 Tyrone (#496); Aug.-Sept. 2001 Trinidad Earthquakes (#520-532); Sept. 8, 2003 Aguilar (#559); Oct. 25, 2003 SW of Trinidad (#560); Jan. 14, 2004 SW of Trinidad (#564)

Faults analyzed for County: Cheraw (H), N Sangre de Cristo (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Cheraw: M7.0 – 0 fatal, \$13.4 Million (-0.4%)

N Sangre: M7.5 – 0 fatal, \$13.0 Million (-0.4%)

M6.5 – 0 fatal, \$0.5 Million (-0.01%)

### **Lincoln County**

Population: 6,087

Growth since 1990: 34.4%

County Size: 2,593 square miles

Inventory: \$1,891.70 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Cheraw: M7.0 – 0 fatal, \$10.4 Million (-0.6%)

### **Logan County**

Population: 20,504

Growth since 1990: 16.7%

County Size: 1,827 square miles

Inventory: \$3,147.30 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

### **Mesa County**

Population: 116,255

Growth since 1990: 24.8%

County Size: 3,312 square miles

Inventory: \$9,847.80 M

Faults within County: Atkinson Mesa (Q), Bangs Canyon (Q), Big Dominguez Creek (Q), Bridgeport (Q), Cactus Park (Q), Glade Park (Q), Granite Creek (Q), Ladder Creek (Q), Little Dolores River (Q), Little Dominguez Creek (Q), Lost Horse Basin (Q), Monitor Creek (Q), Pine

Mountain (Q), Redlands Fault Complex (Q), Ryan Creek (Q), Sinbad Valley Graben (Q), Whitewater (Q), Wolf Hill (Q)

Historical Earthquakes: Feb. 28, 1915 Grand Junction (#28); June 24, 1962 Uncompahgre Plateau (#106); Nov. 12, 1971 Grand Junction (#347); Jan. 30, 1975 N of Grand Junction (#358); Dec. 6, 1985 Gateway (#403); Oct. 21, 1990 Palisade (#452); Apr. 23, 1995 Grand Mesa (#491)

Faults analyzed for County: Cimarron (LQ,Q), Roubideau Creek (H)

Previous studies – perceived hazard: NCEM mentions frequent minor earthquakes

HAZUS Risk:

Cimarron:	M6.75 – 0 fatal, \$4.5 Million (-0.05%)
Roubideau:	M5.5 Normal – 0 fatal, \$0.7 Million (-0.00%)
	M5.5 Reverse – 0 fatal, \$1.4 Million (-0.01%)

## **Mineral County**

<u>Population:</u> 831	<u>Growth since 1990:</u> 48.9%
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<u>County Size:</u> 921 square miles	<u>Inventory:</u> \$679.40 M
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Faults within County: Cannibal (LQ)

Historical Earthquakes: Apr.-May 1928 Creede Earthquakes (#53-66); May 3, 1957 Creede Area (#91); Jan. 23, 1966 Creede (#211)

Faults analyzed for County: Cannibal (LQ)

Previous studies – perceived hazard: NCEM mentions several past earthquakes

HAZUS Risk:

Mineral:	M7.0 – 0 fatal, \$23.3 Million (-3.4%)
	M6.0 – 0 fatal, \$1.3 Million (-0.2%)

## **Moffat County**

<u>Population:</u> 13,184	<u>Growth since 1990:</u> 16.1%
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<u>County Size:</u> 4,754 square miles	<u>Inventory:</u> \$2,833.00 M
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Faults within County: Bakers Peak (LC), Beaver Creek (LC), Browns Park Faults (LC), Craig Faults (LC), Cross Mountain (LC), East (LC), Elk Springs Faults (LC), Elkhead Mountains Faults (LC), Lay Faults (LC), Maybell Faults (LC), Mitten Park (LC), Sawmill Canyon (LC), Sparks Ranch-Uinta (LC), Teepee (LC), Wapiti Peak (LC), Yampa (LC)

Historical Earthquakes: Oct. 1871 Lily Park-Moffat (#2); Dec. 1891 Axial Basin (#14); 1899 Lay (#19); Apr. 1906 Maybell (#23); Summer 1924 Craig (#51); Jul.-Aug. 1942 W Moffat County (#73-74); Jan. 18, 1968 Dinosaur National Monument (#304); Nov. 30, 1978 Craig (#364); Jan. 20, 1979 NW of Craig (#366); Sept. 24, 1983 Browns Park (#379); Feb. 14, 1988 Maybell (#439); Aug. 31, 1988 Cold Spring Mountain (#440); Nov. 15, 1991 Hamilton (#459); Feb. 14, 1994 Craig (#471); Jan. 31, 2002 Axial Basin (#535)

Faults analyzed for County: Mosquito (LQ)

Previous studies – perceived hazard: NCEM mentions six recorded earthquakes

HAZUS Risk:

Mosquito:	M7.0 – 0 fatal, \$0.18 Million (-0.00%)
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## **Montezuma County**

<u>Population:</u> 23,830	<u>Growth since 1990:</u> 27.6%
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<u>County Size:</u> 2,094 square miles	<u>Inventory:</u> \$3,172.20 M
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Faults within County: None  
Historical Earthquakes: None  
Faults analyzed for County:  
Previous studies – perceived hazard: None  
HAZUS Risk:

### **Montrose County**

Population: 33,432                      Growth since 1990: 36.9%  
County Size: 3,007 square miles      Inventory: \$3,914.80 M  
Faults within County: Atkinson Mesa Faults (Q), Big Gypsum Valley Graben Faults (Q), Cimarron (Q, LQ), Clay Creek (Q), Cottonwood Creek Faults (Q), Ellison Gulch Scarp (H), Hanks Creek (Q), Horsefly Creek (Q), Johnson Spring (Q), Love Mesa (Q), Monitor Creek (Q), Montrose Faults SW (Q), Paradox Valley Graben Faults (Q), Pinto Mesa Faults (Q), Red Canyon (Q), Red Rocks (Q), Roubideau Creek (H), Roubideau Creek Faults East (Q), San Miguel Canyon Faults (Q), Sinbad Valley Graben (Q)  
Historical Earthquakes: Jan. 13, 1962 Montrose (#97); May 13, 1989 Uravan (#443); May 15, 1992 Olathe (#464); Sept. 13-15, 1994 Norwood (#475-478); Apr. 10, 1998 Paradox Valley (#502); June-Nov. 1999 Paradox Valley (#504-508); Mar.-May 2000 Paradox Valley (#511-512); June 6, 2002 Paradox Valley (#544)  
Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H)  
Previous studies – perceived hazard: NCEM = 50  
HAZUS Risk:

Busted Boiler:	M6.5 – 3 fatal, \$155.9 Million (-4.0%) M6.0 – 0 fatal, \$38.9 Million (-1.0%) M5.5 – 0 fatal, \$11.2 Million (-0.3%)
Cannibal:	M7.0 – 0 fatal, \$9.9 Million (-0.25%)
Cimarron:	M6.75 – 4 fatal, \$133.5 Million (-3.4%) M6.5 – 1 fatal, \$69.3 Million (-1.8%) M6.0 – 0 fatal, \$15.9 Million (-0.4%) M5.5 – 0 fatal, \$4.1 Million (-0.1%)
Roubideau:	M5.5 Normal – 0 fatal, \$9.5 Million (-0.24%) M5.5 Reverse – 0 fatal, \$17.2 Million (-0.44%) M5.0 Normal – 0 fatal, \$2.5 Million (-0.06%) M5.0 Reverse – 0 fatal, \$4.4 Million (0.11%)

### **Morgan County**

Population: 27,171                      Growth since 1990: 23.8%  
County Size: 1,282 square miles      Inventory: \$5,719.90 M  
Faults within County: None  
Historical Earthquakes: None  
Faults analyzed for County:  
Previous studies – perceived hazard: None  
HAZUS Risk:

## **Otero County**

Population: 20,311

Growth since 1990: 0.6%

County Size: 1,267 square miles

Inventory: \$3,026.80 M

Faults within County: Cheraw (H)

Historical Earthquakes: None

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Otero: M7.0 CEUS – 20 fatal, \$556.2 Million (-18.4%)

M5.5 CEUS – 0 fatal, \$24.3 Million (-0.8%)

## **Ouray County**

Population: 3,742

Growth since 1990: 63.1%

County Size: 540 square miles

Inventory: \$807.70 M

Faults within County: Busted Boiler (LQ), Cow Creek (LC), Log Hill Mesa Graben Faults (LQ), Montrose Faults SW (Q), Ridgway (Q), Ridgway Quarry Faults (LC)

Historical Earthquakes: Aug. 3, 1897 Ridgway (#18); Nov. 11, 1913 Ridgway Area (#25-27); Oct. 11, 1960 Montrose-Ridgway (#92); Feb. 5, 1962 Ridgway-Montrose (#100); Apr. 4, 1967 Montrose (#252); Nov. 19, 1989 Ridgway (#447); Nov. 22, 1989 Ouray (#448); Jan. 17, 1994 Ridgway (#470)

Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Busted Boiler: M6.5 – 5 fatal, \$122.3 Million (-15.1%)

M6.0 – 1 fatal, \$44.1 Million (-5.5%)

M5.5 – 0 fatal, \$14.0 Million (-1.7%)

Cannibal: M7.0 – 0 fatal, \$7.1 Million (-0.9%)

Cimarron: M6.75 – 0 fatal, \$13.1 Million (-1.6%)

M6.5 – 0 fatal, \$9.2 Million (-1.1%)

M6.0 – 0 fatal, \$2.9 Million (-0.36%)

Roubideau: M5.5 Normal – 0 fatal, \$0.26 Million (-0.03%)

M5.5 Reverse – 0 fatal, \$0.54 Million (-0.07%)

## **Park County**

Population: 14,523

Growth since 1990: 102.4%

County Size: 2,166 square miles

Inventory: \$2,919.31 M

Faults within County: Bare Hills (LC), Chase Gulch-East Side (LQ), Chase Gulch-West Side (LQ), Currant Creek Fault Zone (LC), Eleven Mile (LQ), Elevenmile Canyon Reservoir Faults (LC), Frontal (LQ), Hartsel Faults W (LC), High Park Fault Zone (LC), Ilse (LC), Kaufman Ridge (LC), Northeastern Boundary Faults (MLQ), Pulver Gulch-Rocky Gulch (LC), Schoolmarm Mountain (LC), Tarryall (LC), Thirty-nine Mile Mountain (LC),

Historical Earthquakes: Nov. 27, 1961 South Park (#95-96); Apr. 3, 1966 Blast in South Park (#221)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sangre (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Williams Fork (H)

Previous studies – perceived hazard: NCEM mentions faults and one earthquake

HAZUS Risk:

Chase Gulch:	M6.75 – 2 fatal, \$118.5 Million (-4.1%)
	M6.5 – 1 fatal, \$77.4 Million (-2.7%)
	M6.0 – 0 fatal, \$22.5 Million (-0.8%)
	M5.5 – 0 fatal, \$6.0 Million (-0.2%)
Frontal:	M7.0 – 0 fatal, \$32.9 Million (-1.1%)
	M5.5 – 0 fatal, \$0.5 Million (-0.02%)
Mosquito:	M7.0 – 2 fatal, \$84.0 Million (-2.9%)
	M5.5 – 0 fatal, \$5.6 Million (-0.2%)
N Sangre:	M7.5 – 0 fatal, \$10.4 Million (-0.35%)
N Sawatch:	M7.0 – 0 fatal, \$16.9 Million (-0.6%)
	M6.0 – 0 fatal, \$2.2 Million (-0.07%)
S Sawatch:	M7.25 – 0 fatal, \$16.2 Million (-0.6%)
	M7.0 – 0 fatal, \$11.1 Million (-0.4%)
	M6.5 – 0 fatal, \$4.1 Million (-0.14%)
	M6.0 – 0 fatal, \$1.2 Million (-0.04%)
Ute Pass:	M7.0 – 0 fatal, \$8.5 Million (-0.3%)
Williams Fork:	M6.75 – 0 fatal, \$6.6 Million (-0.22%)

**Phillips County**

Population: 4,480

Growth since 1990: 6.9%

County Size: 680 square miles

Inventory: \$1,173.30 M

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

**Pitkin County**

Population: 14,872

Growth since 1990: 17.5%

County Size: 974 square miles

Inventory: \$2,361.30 M

Faults within County: Basalt Mountain Fault (Q), Sawatch Range Faults (LC)

Historical Earthquakes: Sept. 17, 1880 Aspen (#4); Apr. 8, 1940 Aspen (#68); Feb. 1941 Aspen (#69-71); Oct. 17, 1960 Aspen (#94); Mar. 5, 1962 Aspen (#101); June 23, 1968 SW of Carbondale (#310); Sept. 24, 1977 SW of Carbondale (#360); May 29, 1978 SW of Carbondale (#362); Apr.-May 1984 Carbondale Earthquakes (#381-399); Apr. 21, 1991 Aspen (#454); July 7-8, 1993 Aspen (#466-469); Oct. 13, 2002 Aspen (#550); Jan. 1, 2003 Aspen (#553); Nov. 6, 2003 Aspen (#561)

Faults analyzed for County: Chase Gulch (LQ), Cimarron (LQ,Q), Frontal (LQ), Mosquito (LQ), N Sangre (H), N Sawatch (LQ), S Sawatch (H), Williams Fork (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Chase Gulch: M6.75 – 0 fatal, \$1.0 Million (-0.04%)

Cimarron:	M6.75 – 0 fatal, \$2.3 Million (-0.09%)
Frontal:	M7.0 – 0 fatal, \$5.2 Million (-0.22%)
Mosquito:	M7.0 – 0 fatal, \$10.4 Million (-0.44%)
N Sangre:	M7.5 – 0 fatal, \$2.6 Million (-0.1%)
N Sawatch:	M7.0 – 2 fatal, \$77.0 Million (-3.3%)
	M6.0 – 0 fatal, \$5.3 Million (-0.2%)
S Sawatch:	M7.25 – 0 fatal, \$31.7 Million (-1.3%)
Williams Fork:	M6.75 – 0 fatal, \$2.1 Million (-0.09%)

# Prowers County

Population: 14,483

Growth since 1990: 8.5%

County Size: 1,626 square miles

Inventory: \$2,365.80 M

Faults within County: None

Historical Earthquakes: Sept. 29, 1928 Holly (#67); Jan. 14, 1956 Lamar (#89-90); Apr. 21, 1968 S of Holly (#307); Jan. 10, 2003 Lamar (#554)

Faults analyzed for County: Cheraw (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Cheraw: M7.0 – 0 fatal, \$27.6 Million (-1.2%)

# Pueblo County

Population: 141,472

Growth since 1990: 15.0%

County Size: 2,401 square miles

Inventory: \$11,053.80 M

Faults within County: Goodpasture (Q), Greenhorn (LC), Ilse (LC), Wet Mountain (LC)

Historical Earthquakes: Dec. 4, 1870 Pueblo-Ft. Reynolds (#1); Nov. 13, 1963 Pueblo (#144)

Faults analyzed for County: Cheraw (H), Goodpasture (Q), Rampart (MLQ), N Sangre (H), Ute Pass (MLQ)

Previous studies – perceived hazard: None

HAZUS Risk:

**Cheraw:** M7.0 WUS – 0 fatal, \$10.9 Million (-0.09%)

M5.5 WUS– 0 fatal, \$0.02 Million (-0.00%)

Goodpasture: M6.0 WUS – 1 fatal, \$69.9 Million (-0.6%)

**M5.5 WUS – 0 fatal, \$22.1 Million (-0.2%)**

Rampart: M7.0 CEUS – 1 fatal, \$131.8 Million (-1.2%)

N Sangre: M7.5 WUS – 0 fatal, \$32.3 Million (-0.3%)

Ute Pass: M7.0 WUS – 0 fatal, \$76.6 Million (-0.7%)

## Rio Blanco County

Population: 5,986

Growth since 1990: -1.1%

County Size: 3,263 square miles

Inventory: \$1,601.40 M

Faults within County: Blue Lake-Heart Lake Faults (LC), Fish Creek Faults (LC), Killarney Faults (Q), West Coal Creek (LC)

Historical Earthquakes: Feb. 21, 1954 Rangely-Grand Junction (#83); July 5-6, 1966 Rangely (#230-232); Feb. 15, 1967 Rangely (#249-250); Apr. 21, 1970 Rangely (#337-338); May 17, 1973 Rio Blanco AEC Test (#351); Mar. 19, 1979 Rangely (#367); Mar. 29, 1979 Rangely

(#368); June 30, 1989 Meeker (#444); Nov. 3, 1994 Meeker (#481); Mar.-Apr. 1995 Dinosaur National Monument (#486-490)

Faults analyzed for County: Mosquito (LQ)

Previous studies – perceived hazard: NCEM = 100+

HAZUS Risk:

Mosquito: M7.0 – 0 fatal, \$0.01 Million (-0.00%)

## **Rio Grande County**

Population: 12,413 Growth since 1990: 15.3%

County Size: 916 square miles Inventory: \$1,842.40 M

Faults within County: Del Norte Peak Faults (LC), Monte Vista Faults (Q), Monte Vista Faults West (LC), Summitville Faults (LC)

Historical Earthquakes: Jan. 15, 1988 Summitville (#438); May 10, 1991 Summitville (#455-458)

Faults analyzed for County: N Sangre de Cristo (H)

Previous studies – perceived hazard: NCEM = 100

HAZUS Risk:

N Sangre: M7.5 – 0 fatal, \$15.4 Million (-0.8%)

## **Routt County**

Population: 19,690 Growth since 1990: 39.8%

County Size: 2,330 square miles Inventory: \$3,251.90 M

Faults within County: Blacktail Mountain Faults (LC), Brush Mountain (LC), Diamond Peak Faults (LC), Fish Creek Faults (LC), Gardner Reservoir Faults (LC), Green Ridge (LC), Grouse Mountain (LC), Hahns Peak Faults (LC), Hinman Creek (LC), King Solomon (LC), Kremmling Faults (LC), Lawson Creek (LC), Lester Creek Reservoir (LC), Little Rock Creek (LC), Lone Spring Faults (LC), Milner Faults (LC), Morrison Creek (LC), Newcomer Creek Faults (LC), Park Range Faults (LC), Rabbit Ears Pass Faults (LC), Reed Creek (LC), Sand Mountain (LC), Sierra Madre Range Faults (LC), Silver City Creek (LC), Silver Creek (LC), Spillway (LC), Steamboat Lake (LC), Steamboat Springs Fault Zone (LC), Trail Creek (LC), Twentymile Park Faults (LC), Wheeler Creek (LC), Willow Creek Structural Zone (LC), Yampa (LC)

Historical Earthquakes: Mar. 22, 1895 Steamboat Springs (#17); Feb. 10, 1955 Steamboat Springs (#84); Nov. 1, 1966 Yampa (#238); Jan. 18, 1967 Flat Tops (#245); Mar. 18, 1971 Clark (#343); Mar. 31, 1974 Clark (#357); Apr. 29, 1993 Clark (#465); Feb. 2000 E of Steamboat Springs (#509-510); July 30, 2000 Steamboat Springs (#513); Mar. 23, 2002 Steamboat Springs (#537); Apr. 2002 Steamboat Springs (#541-542)

Faults analyzed for County: Frontal (LQ), Mosquito (LQ), Williams Fork (H)

Previous studies – perceived hazard: None

HAZUS Risk:

Frontal: M7.0 – 0 fatal, \$6.9 Million (-0.2%)

Mosquito: M7.0 – 0 fatal, \$2.4 Million (-0.07%)

Williams Fork: M6.75 – 0 fatal, \$5.2 Million (-0.16%)

## **Saguache County**

Population: 5,917 Growth since 1990: 28.1%

County Size: 3,144 square miles      Inventory: \$1,539.12 M  
Faults within County: Alamosa Horst Fault Zone-East (LC), Cimarron Fault-Powderhorn Section (LC), Houselog Creek Faults (LC), Kerber Creek (LC), Lucky Boy (LQ), Mineral Hot Springs (LQ), North Sangre de Cristo (H), Poncha Pass Faults (LC), Saguache Creek Faults (LC), Squaw Creek Faults (LC), Villa Grove Fault Zone (H), Western Boundary (LQ)  
Historical Earthquakes: None  
Faults analyzed for County: Cannibal (LQ), N Sangre de Cristo (H), S Sawatch (H)  
Previous studies – perceived hazard: NCEM mentions Rio Grande Rift  
HAZUS Risk:  
Cannibal:      M7.0 – 0 fatal, \$1.6 Million (-0.1%)  
N Sangre:      M7.5 – 0 fatal, \$29.3 Million (-1.9%)  
                    M6.5 – 0 fatal, \$10.9 Million (-0.7%)  
                    M5.5 – 0 fatal, \$1.7 Million (-0.1%)  
S Sawatch:      M7.25 – 0 fatal, \$7.7 Million (-0.5%)

### **San Juan County**

Population: 558      Growth since 1990: -25.1%  
County Size: 392 square miles      Inventory: \$377.10 M  
Faults within County: None  
Historical Earthquakes: Nov. 23, 1882 Silverton (#10); Apr. 29, 1945 Silverton (#77-78); Jan. 16, 1967 Silverton (#244); June 18, 2002 SE of Silverton (#545)  
Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ)  
Previous studies – perceived hazard: None  
HAZUS Risk:  
Busted Boiler: M6.5 – 0 fatal, \$0.9 Million (-0.23%)  
Cannibal:      M7.0 – 0 fatal, \$1.0 Million (-0.28%)

### **San Miguel County**

Population: 6,594      Growth since 1990: 80.5%  
County Size: 1,283 square miles      Inventory: \$1,421.60 M  
Faults within County: Big Gypsum Valley Graben Faults (Q), Dolores Fault Zone (Q), San Miguel Canyon Faults (Q)  
Historical Earthquakes: Jan. 1, 1894 Telluride (#15); Feb. 3, 1970 S of Norwood (#335); Sept. 13-15, 1994 Norwood (#475-478)  
Faults analyzed for County: Busted Boiler (LQ), Roubideau (H)  
Previous studies – perceived hazard: NCEM = 100  
HAZUS Risk:

### **Sedgwick County**

Population: 2,747      Growth since 1990: 2.1%  
County Size: 544 square miles      Inventory: \$1,085.80 M  
Faults within County: None  
Historical Earthquakes: None

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

### **Summit County**

Population: 23,548

Growth since 1990: 82.8%

County Size: 612 square miles

Inventory: \$4,443.10 M

Faults within County: Blue River Graben Faults (LC), Blue River Fault West (LC), Frontal (LQ), Gore (LC), Green Mountain Reservoir Faults (LC), Mosquito (LQ), Mount Powell Faults (LC), Sheephorn Mountain Faults (LC)

Historical Earthquakes: Aug. 4, 1964 Dillon (#149); Sept. 12, 1990 Vail (#449)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Williams Fork (H)

Previous studies – perceived hazard: NCEM mentions Gore and Frontal faults and previous earthquakes M4.0-4.9

HAZUS Risk:

Chase Gulch:	M6.75 – 0 fatal, \$8.5 Million (-0.2%)
Frontal:	M7.0 – 29 fatal, \$895 Million (-20.1%)
	M6.5 – 6 fatal, \$348 Million (-7.8%)
	M6.0 – 1 fatal, \$90 Million (-2.0%)
	M5.5 – 0 fatal, \$25.5 Million (-0.6%)
Golden:	M6.5 – 0 fatal, \$2.4 Million (-0.05%)
Mosquito:	M7.0 – 18 fatal, \$660 Million (-14.9%)
	M6.5 – 6 fatal, \$288 Million (-6.5%)
	M6.0 – 0 fatal, \$77.2 Million (-1.7%)
	M5.5 – 0 fatal, \$20.6 Million (-0.5%)
N Sangre:	M7.5 – 0 fatal, \$2.5 Million (-0.05%)
N Sawatch:	M7.0 – 0 fatal, \$21 Million (-0.5%)
	M6.5 – 0 fatal, \$8.6 Million (-0.2%)
S Sawatch:	M7.25 – 0 fatal, \$14 Million (-0.3%)
Ute Pass:	M7.0 – 0 fatal, \$1.8 Million (-0.04%)
Williams Fork:	M6.75 – 3 fatal, \$186.4 Million (-4.2%)
	M6.0 – 0 fatal, \$39.7 Million (-0.9%)
	M5.5 – 0 fatal, \$13 Million (-0.3%)

### **Teller County**

Population: 20,555

Growth since 1990: 64.9%

County Size: 554 square miles

Inventory: \$2,074.20 M

Faults within County: Bare Hills (LC), Colorado Springs Faults (LC), Fourmile Creek (LC), Hay Creek (LC), High Park Fault Zone (LC), Midland (LC), Oil Creek (LC), Raspberry Mountain (LC), Ute Pass Fault Zone (MLQ)

Historical Earthquakes: Jan. 6, 1979 Divide (#365); Dec. 23 and 31, 1995 Manitou Springs (#492-493); Jan. 1997 Woodland Park (#497-499); Apr. 18, 1998 Woodland Park (#503); July 22, 2001 Woodland Park (#515); Feb. 19, 2003 Woodland Park (#556)

Faults analyzed for County: Chase Gulch (LQ), Rampart Range (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)

Previous studies – perceived hazard: NCEM mentions 1979 Divide earthquake

HAZUS Risk:

Chase Gulch:	M6.75 – 0 fatal, \$19 Million (-0.9%)
Rampart:	M7.0 – 5 fatal, \$160 Million (-7.7%)
	M6.5 – 2 fatal, \$86 Million (-4.1%)
	M6.0 – 0 fatal, \$33.5 Million (-1.6%)
	M5.5 – 0 fatal, \$11.6 Million (-0.6%)
N Sangre:	M7.5 – 0 fatal, \$11.8 Million (-0.6%)
S Sawatch:	M7.25 – 0 fatal, \$4.1 Million (-0.2%)
Ute Pass:	M7.0 – 21 fatal, \$418.3 Million (-20.2%)
	M5.5 – 0 fatal, \$25.4 Million (-1.2%)

**Washington County**

Population: 4,926 Growth since 1990: 2.4%

County Size: 2,525 square miles Inventory: \$2,170.00 M

Faults within County: High Plains Grabens under investigation

Historical Earthquakes: None

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

**Weld County**

Population: 180,936 Growth since 1990: 37.3%

County Size: 4,004 square miles Inventory: \$15,410.00 M

Faults within County: None

Historical Earthquakes: May 26, 1969 E of Greeley (#328)

Faults analyzed for County: Golden (Q)

Previous studies – perceived hazard: None

HAZUS Risk:

Golden:	M6.5 WUS – 0 fatal, \$52.2 Million (-0.3%)
	M6.5 CEUS – 1 fatal, \$227 Million (-1.5%)

**Yuma County**

Population: 9,841 Growth since 1990: 9.9%

County Size: 2,370 square miles Inventory: \$2,678.40 M

Faults within County: High Plains Grabens under investigation

Historical Earthquakes: None

Faults analyzed for County:

Previous studies – perceived hazard: None

HAZUS Risk:

## Fault Scenarios for Counties within 150km

WUS: Western U.S. Attenuation Function

CEUS: Central U.S. Attenuation Function

<b>Fault Scenario (Counties within 150km)</b>	<b>Magnitude</b>	<b>Total Economic Loss</b>	<b>Fatalities</b>	<b>Loss Ratio</b>
1882 Historical WUS	6.2	\$322.2 Million	2	0.11%
1882 Historical WUS	6.6	\$2,392.9 Million	18	0.84%
Chase Gulch Fault WUS	6.75	\$436 Million	3	0.14%
Chase Gulch Fault WUS	6.5	\$278 Million	2	0.09%
Chase Gulch Fault WUS	6.0	\$75 Million	0	0.00%
Chase Gulch Fault WUS	5.5	\$10.8 Million	0	0.00%
Frontal Fault WUS	7.0	\$1,724 Million	63	0.53%
Frontal Fault WUS	6.0	\$230 Million	2	0.07%
Frontal Fault WUS	5.5	\$67 Million	0	0.02%
Mosquito Fault WUS	7.0	\$1,518 Million	46	0.5%
Mosquito Fault WUS	6.0	\$206.1 Million	2	0.15%
Mosquito Fault WUS	5.5	\$57.1 Million	0	0.01%
N. Sangre de Cristo Fault WUS	7.5	\$887 Million	24	0.6%

N. Sangre de Cristo Fault WUS	7.0	\$194 Million	1	0.0%
N. Sangre de Cristo Fault WUS	6.0	\$19.4 Million	0	0.01%
Northern Sawatch Fault WUS	7.0	\$721 Million	19	0.2%
Northern Sawatch Fault WUS	5.5	\$32 Million	0	0.0%
Southern Sawatch Fault WUS	7.25	\$963 Million	37	0.32%
Southern Sawatch Fault WUS	6.5	\$266 Million	6	0.08%
Williams Fork Valley Fault WUS	6.75	\$638 Million	10	0.2%
Williams Fork Valley Fault WUS	6.0	\$127 Million	1	0.04%
Williams Fork Valley Fault WUS	5.5	\$36 Million	0	0.00%
Cheraw Fault CEUS	7.0	\$1,353 Million	27	1.0%
Cheraw Fault CEUS	6.0	\$148 Million	1	0.1%
Cheraw Fault CEUS	5.5	\$44.3 Million	0	0.03%
Golden Fault CEUS	6.5	\$22,079 Million	719	7.3%
Golden Fault CEUS	6.0	\$11,414.4 Million	190	3.75%
Golden Fault CEUS	5.5	\$4,409.1 Million	20	1.45%

Golden Fault CEUS	5.0	\$1,498.7 Million	2	0.49%
Goodpasture Fault CEUS	6.0	\$548.8 Million	3	0.4%
Goodpasture Fault CEUS	5.5	\$178.7 Million	0	0.13%
Rampart Range Fault WUS	7.0	\$11,248 Million	671	3.5%
Rampart Range Fault CEUS	7.0	\$18,257 Million	571	5.7%
Rampart Range Fault WUS	6.5	\$3,615 Million	122	1.1%
Rampart Range Fault CEUS	6.5	\$7,041 Million	128	2.2%
Rampart Range Fault WUS	6.0	\$1,040 Million	14	0.3%
Rampart Range Fault CEUS	6.0	\$2,978 Million	30	0.9%
Rampart Range Fault CEUS	5.5	\$1,067 Million	4	0.33%
Rocky Mountain Arsenal Fault CEUS	6.5	\$24,832 Million	886	8.46%
Rocky Mountain Arsenal Fault CEUS	6.0	\$12,128 Million	223	4.13%
Rocky Mountain Arsenal Fault CEUS	5.5	\$1,530.5 Million	2	0.52%
Ute Pass Fault Zone WUS	7.0	\$9,771 Million	614	3.0%
Ute Pass Fault Zone CEUS	7.0	\$12,888 Million	334	3.94%

Ute Pass Fault Zone CEUS	6.5	\$6,506 Million	144	1.98%
Ute Pass Fault Zone CEUS	6.0	\$3,109 Million	40	0.95%
Ute Pass Fault Zone CEUS	5.5	\$1,178 Million	4	0.36%

Valmont Fault CEUS	5.0	\$1,141 Million	2	0.38%
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Walnut Creek Fault CEUS	6.0	\$13,251 Million	248	4.3%
Walnut Creek Fault CEUS	5.0	\$1,695.9 Million	2	0.55%

Busted Boiler Fault WUS	6.5	\$333.5 Million	9	0.6%
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Busted Boiler Fault WUS	6.0	\$97 Million	1	0.18%
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Busted Boiler Fault WUS	5.5	\$29 Million	0	0.05%
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Cannibal Fault WUS	7.0	\$124.4 Million	1	0.18%
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Cannibal Fault WUS	6.5	\$36.8 Million	0	0.05%
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Cannibal Fault WUS	6.0	\$10.1 Million	0	0.01%
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Cannibal Fault WUS	5.5	\$2.4 Million	0	0.00%
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Cimarron Fault WUS	6.75	\$199 Million	4	0.28%
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Cimarron Fault WUS	6.0	\$26 Million	0	0.03%
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Cimarron Fault WUS	5.5	\$6.7 Million	0	0.01%
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Roubideau Creek East Fault WUS	5.5	\$12.9 Million	0	0.02%
Roubideau Creek East Fault WUS – Non Extentional	5.5	\$23.8 Million	0	0.04%
Roubideau Creek East Fault WUS	5.0	\$3 Million	0	0.00%

### HAZUS Top Fives

#### Most damaging faults:

1. Rocky Mountain Arsenal
2. Golden
3. Rampart Range
4. Ute Pass
5. Walnut Creek

#### Total direct economic loss:

1. Rocky Mountain Arsenal M6.5 Counties 150km CEUS – \$24.83 Billion
2. Golden M6.5 Counties 150km CEUS - \$22.08 Billion
3. Rampart Range M7 Counties 150km CEUS - \$18.26 Billion
4. Walnut Creek M6 Counties 150km CEUS - \$13.25 Billion
5. Ute Pass M7 Counties 150km CEUS – \$12.88 Billion
6. Rocky Mountain Arsenal M6 Counties 150km CEUS - \$12.13 Billion
7. Golden M6 Counties 150km CEUS - \$11.41 Billion
8. Rampart Range M7 Counties 150km WUS - \$11.25 Billion
9. Ute Pass M7 Counties 150km WUS - \$9.77 Billion
10. Ute Pass M7 Reverse El Paso County WUS – \$9.30 Billion
11. Rampart Range M7 El Paso County WUS - \$8.15 Billion
12. Golden M6.5 Jefferson County CEUS - \$8.14 Billion
13. Ute Pass M7 El Paso County WUS - \$7.92 Billion
14. Rampart M6.5 Counties 150km CEUS - \$7.04 Billion

#### Highest loss ratio:

1. Rocky Mountain Arsenal M6.5 Adams County CEUS – 29.7%
2. Ute Pass M7 Reverse El Paso County WUS – 26.8 %
3. South Sawatch M7.25 Chaffee County WUS – 24.1%
4. Rampart M7 El Paso County WUS – 23.5%
5. Ute Pass M7 El Paso County WUS – 22.9%

#### Counties at greatest risk (high monetary loss, casualties, and loss ratios):

1. El Paso County
2. Jefferson County
3. Denver County
4. Summit County
5. Chaffee County

## Locations and Names of the Faults Analyzed



## Top 5 Total Direct Economic Loss

